Chapter 5
Ignition system

Contents

Degrees of difficulty

Easy, suitable for novice with little experience	**Fairly easy,** suitable for beginner with some experience	**Fairly difficult,** suitable for competent DIY mechanic	**Difficult,** suitable for experienced DIY mechanic	**Very difficult,** suitable for expert DIY or professional

Specifications

General

Cylinder numbering	Rear left – 1, front left – 2, rear right – 3, front right – 4
Spark plugs	see Chapter 1

Ignition timing

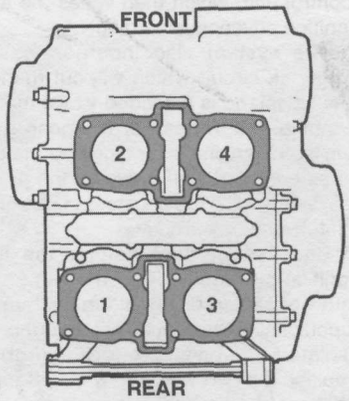
At idle	3° BTDC @ 1000 rpm
Full advance	
1985 to 1989 models	43° BTDC @ 9000 rpm
1990 to 2003 UK models	31° BTDC @ 9000 rpm
1990 to 2003 US 49-state models	33° BTDC @ 9000 rpm
1990 to 2003 California models	43° BTDC @ 9000 rpm

Pick-up coil

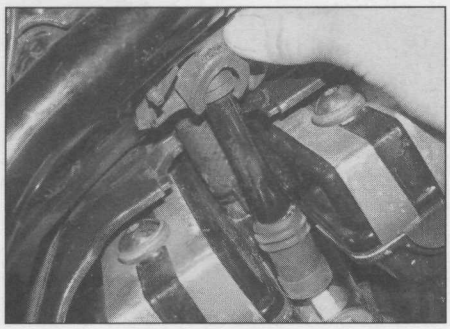
Resistance	
1985 to 1989 models	94 to 126 ohms @ 20°C
1990 to 2003 models	81 to 121 ohms @ 20°C

Ignition HT coils

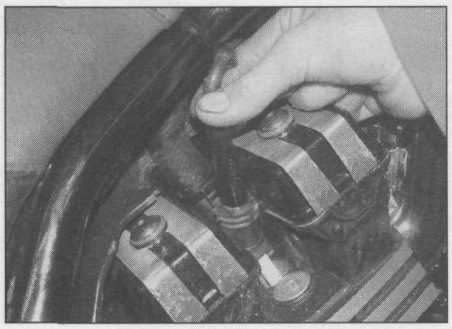
Primary winding resistance	2.4 to 3.0 ohms @ 20°C
Secondary winding resistance (without plug caps)	10.5 to 15.8 K-ohms @ 20°C
Spark plug cap resistance	approx. 10 K-ohms @ 20°C
Minimum spark gap (see Section 2)	6 mm



Cylinder identification



2.2a On the rear cylinders detach the cap cover from the heat shield



2.2b Pull the cap off the spark plug

1 General information

All models are fitted with a fully transistorised electronic ignition system, which due to its lack of mechanical parts is totally maintenance free. The system comprises a trigger, pick-up coil(s), ignition control unit and ignition HT coils (refer to the wiring diagrams at the end of Chapter 9 for details). All models are fitted with four HT coils, one for each cylinder. Models up to 1989 had two-pick-up coils, but in 1990 the ignition system was uprated to digital with only one pick-up coil.

The ignition trigger, which is on the alternator rotor on the left-hand end of the crankshaft, magnetically operates the pick-up coil(s) as the crankshaft rotates. The pick-up coil sends a signal to the ignition control unit which then supplies the ignition HT coils with the power necessary to produce a spark at the plugs.

The system incorporates an advance unit that senses the amount of vacuum (load) in the intake duct on No. 2 cylinder, translates this into a voltage that is output to the ignition control unit, which then varies the amount of ignition advance accordingly.

The system also incorporates a safety interlock circuit which will cut the ignition if the sidestand is extended whilst the engine is running and in gear, or if a gear is selected whilst the engine is running and the sidestand is extended. It also prevents the engine from being started if the engine is in gear unless the clutch lever is pulled in.

Because of their nature, the individual ignition system components can be checked but not repaired. If ignition system troubles occur, and the faulty component can be isolated, the only cure for the problem is to replace the part with a new one. Keep in mind that most electrical parts, once purchased, cannot be returned. To avoid unnecessary expense, make very sure the faulty component has been positively identified before buying a replacement part.

Note that there is no provision for adjusting the ignition timing on these models.

2 Ignition system – check

Warning: The energy levels in electronic systems can be very high. On no account should the ignition be switched on whilst the plugs or plug caps are being held. Shocks from the HT circuit can be most unpleasant. Secondly, it is vital that the engine is not turned over or run with any of the plug caps removed, and that the plugs are soundly earthed (grounded) when the system is checked for sparking. The ignition system components can be seriously damaged if the HT circuit becomes isolated.

1 As no means of adjustment is available, any failure of the system can be traced to failure of a system component or a simple wiring fault. Of the two possibilities, the latter is by far the most likely. In the event of failure, check the system in a logical fashion, as described below.

2 Work on one cylinder at a time. When working on the rear cylinder spark plugs detach the plug cap cover from the heat shield, noting how it fits **(see illustration)**. Pull the cap off the spark plug **(see illustration)**. Fit a spare spark plug, that is known to be good, into the cap and lay the plug against the cylinder head with the threads contacting it. If necessary, hold the spark plug with an insulated tool.

Warning: Do not remove any of the spark plugs from the engine to perform this check – atomised fuel being pumped out of the open spark plug hole could ignite, causing severe injury! Make sure the plugs are securely held against the engine – if they are not earthed when the engine is turned over, the ignition control unit could be damaged.

3 Check that the kill switch is in the 'RUN' position and the transmission is in neutral, then turn the ignition switch ON and turn the engine over on the starter motor. If the system is in good condition a regular, fat blue spark should be evident at the plug electrodes. If the spark appears thin or yellowish, or is non-existent, further investigation will be necessary. Turn the ignition off and repeat the test for each spark plug lead in turn.

4 The ignition system must be able to produce a spark which is capable of jumping a particular size gap. Yamaha specify that a healthy system should produce a spark capable of jumping at least 6 mm. Simple ignition spark gap testing tools are commercially available, some of which are adjustable – follow the manufacturer's instructions, and check each spark plug.

5 If the test results are good the entire ignition system can be considered good. If the spark appears thin or yellowish, or is non-existent, further investigation is necessary.

6 Ignition faults can be divided into two categories, namely those where the ignition system has failed completely, and those which are due to a partial failure. The likely faults are listed below, starting with the most probable source of failure. Work through the list systematically, referring to the subsequent sections for full details of the necessary checks and tests, and to the *Wiring Diagrams* at the end of Chapter 9. **Note:** *Before checking the following items ensure that the battery is fully charged and that all fuses are in good condition.*

a) Loose, corroded or damaged wiring connections, broken or shorted wiring between any of the component parts of the ignition system (see Chapter 9).
b) Faulty HT lead or spark plug cap, faulty spark plug, dirty, worn or corroded plug electrodes, or incorrect gap between electrodes.
c) Faulty ignition (main) switch or engine kill switch (see Chapter 9).
d) Faulty neutral, clutch or sidestand switch, diode unit or starter circuit cut-off relay (see Chapter 9).
e) Faulty pick-up coil or damaged trigger.
f) Faulty ignition HT coil(s).
g Faulty ignition advance unit.
h) Faulty ignition control unit.

7 If the above checks don't reveal the cause of the problem, have the ignition system tested by a Yamaha dealer.

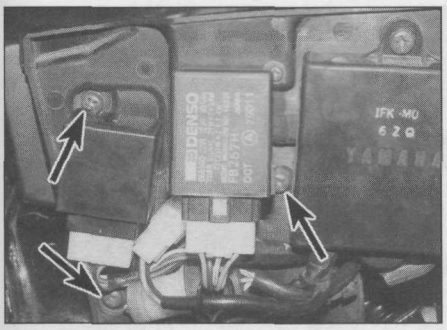
3 Ignition HT coil assembly – check, removal and installation

Check

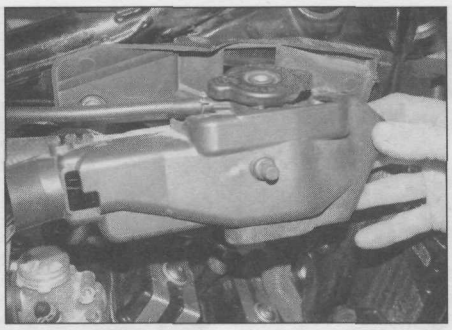
1 Make sure the ignition is switched OFF.

2 The front cylinder coils are mounted on the bracket behind the steering head – remove the air filter housing for access (see Chapter 4). The rear cylinder coils are mounted on the bracket under the rider's seat – remove the seat for access (see Chapter 8). Check the coils visually for cracks, loose wiring connectors and leads, and other damage.

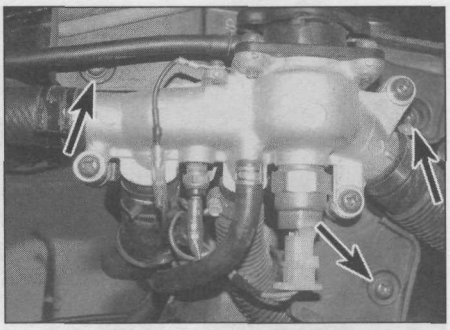
3 The coils can be tested in situ, but the front ones are difficult to access, so remove them



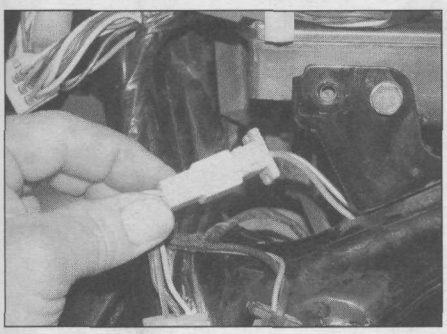
3.4a Undo the screws (arrowed) and displace the board



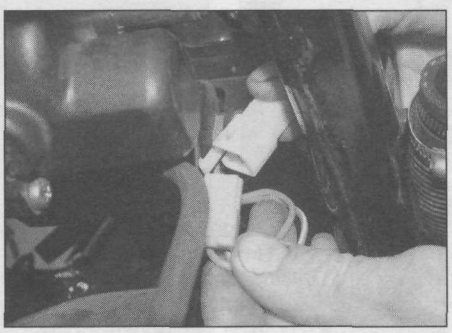
3.4b Remove the filler neck cover . . .



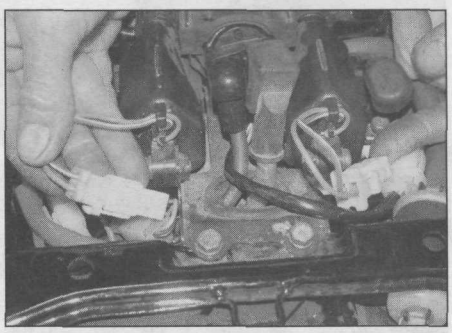
3.4c . . . then undo the screws (arrowed) and displace the board



3.5a No. 2 cylinder coil wiring connector



3.5b No. 4 cylinder coil wiring connector



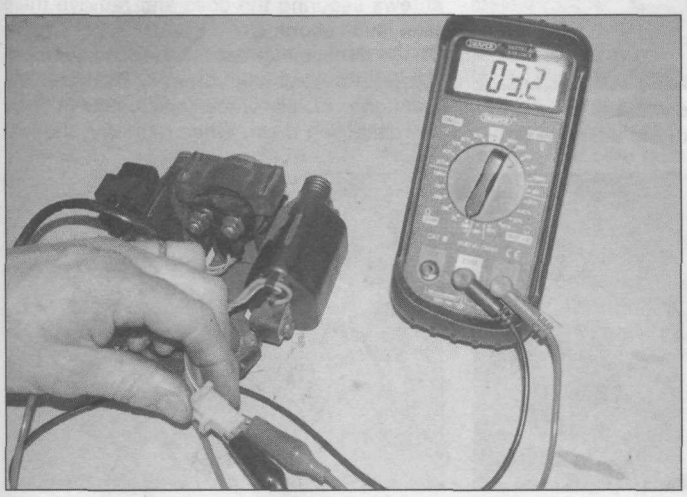
3.5c Nos. 1 and 3 cylinder coil wiring connectors

as described below if required. If you do not remove them, pull the caps off the spark plugs **(see illustrations 2.2a and b)**.

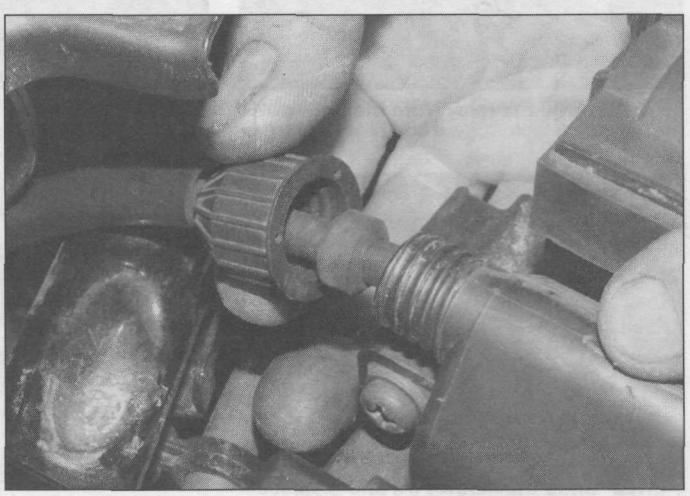
4 To test the front cylinder coils in situ, undo the screws securing the electrical component board on the left-hand side of the steering head and displace it **(see illustration)**. There is no need to disconnect any wiring connectors or detach any of the components from the board. Remove the cover from the radiator filler neck on the right-hand side of the frame **(see illustration)**. Undo the screws securing the radiator filler neck mounting board and displace it – there is no need to drain the cooling system or detach any hoses, but watch the wiring and disconnect the connectors if necessary **(see illustration)**.

5 Measure the primary circuit resistance with an ohmmeter or multimeter as follows: disconnect the primary circuit wiring connector for the coil being tested **(see illustrations)**. Set the meter to the ohms x 1 scale and measure the resistance between the terminals on the coil side of the connector **(see illustration)**. If the reading obtained is not within the range shown in the Specifications, it is likely that the coil is defective.

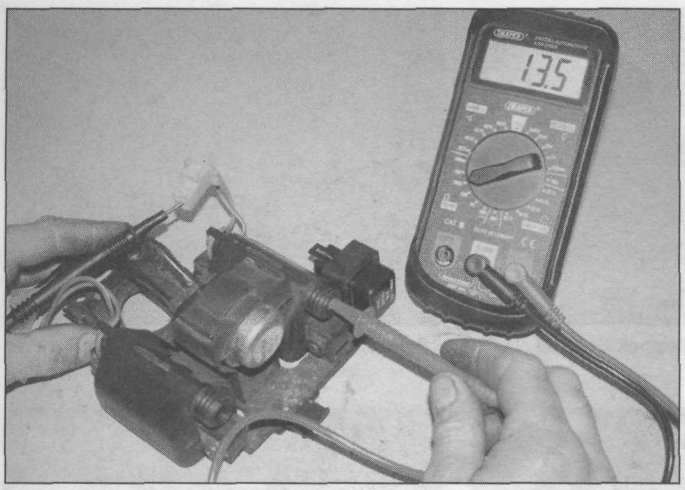
6 Measure the secondary circuit resistance with a multimeter as follows: unscrew the HT lead from the coil being tested **(see illustration)**. Set the meter to the K-ohm scale. Connect the positive (+ve) meter probe to the HT lead socket terminal and the negative (–ve) probe to the red/white wire terminal in the primary circuit wiring connector



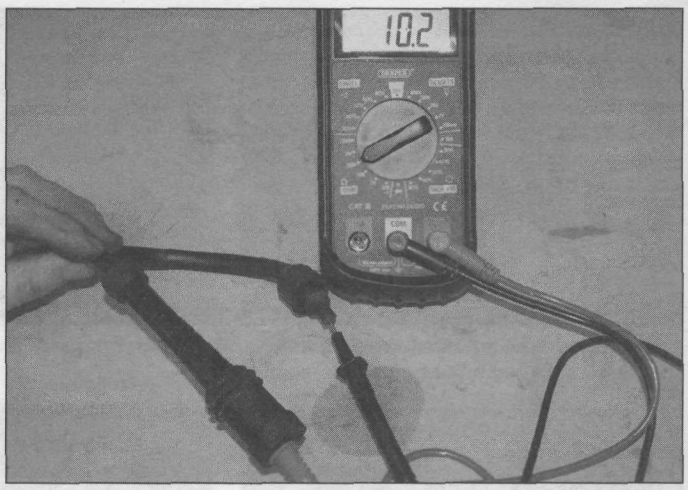
3.5d To test the coil primary resistance, connect the multimeter leads between the primary circuit connector terminals



3.6a Thread the retainer off the coil and detach the HT lead



3.6b To test the coil secondary resistance, connect the probes to the HT lead socket and the specified connector terminal



3.7 Measuring the resistance of the spark plug cap and lead

(see illustration). If the reading obtained is not within the range shown in the Specifications, it is likely that the coil is defective.

7 If the reading is as specified, measure the resistance of the spark plug cap and HT lead by connecting the meter probes between the HT lead end and the spark plug contact in the cap **(see illustration)**. If the reading obtained is not as specified, replace the spark plug cap with a new one.

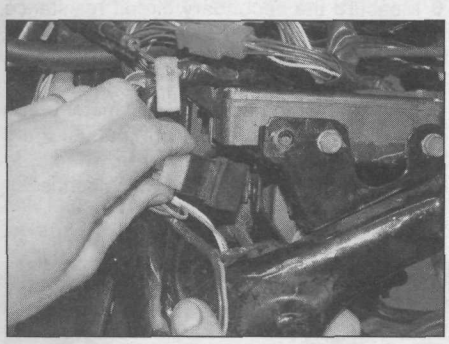
8 If any coil is confirmed to be faulty, it must be replaced with a new one: the coils are sealed units and cannot therefore be repaired.

Removal

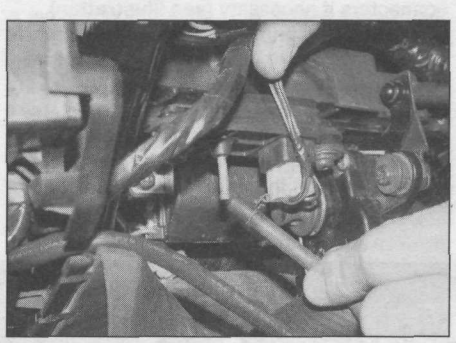
9 Make sure the ignition is switched OFF.

10 To remove the front cylinder coils, remove the air filter housing, and for best access the carburettors (see Chapter 4). Undo the screws securing the electrical component board on the left-hand side of the steering head and displace it **(see illustration 3.4a)**. There is no need to disconnect any wiring connectors or detach any of the components from the board. Remove the cover from the radiator filler neck on the right-hand side of the frame **(see illustration 3.4b)**. Undo the screws securing the radiator filler neck mounting board and displace it – there is no need to drain the cooling system or detach any hoses, but watch the wiring and disconnect the connectors if necessary **(see illustration 3.4c)**. Mark the locations of all wires and leads before disconnecting them. Free the relay from its mount on the left-hand side of the coil mounting bracket **(see illustration)**. Disconnect the ignition advance unit vacuum hose and wiring connector **(see illustration)**. Undo the two screws securing the V-Boost servo motor and displace it (full power models) **(see illustration)**. Unscrew the four bolts securing the bracket and manoeuvre it out, and disconnect the ignition control unit wiring connectors **(see illustration)**, and the coil primary circuit wiring connectors **(see illustrations 3.5a and b)**, then either unscrew the HT lead retainers and detach the leads from the coils, or pull the caps off the spark plugs leaving the HT leads attached to the coils – note the routing of the leads. Remove the bracket from the bike, then undo the screws securing the coils and remove them **(see illustration)**.

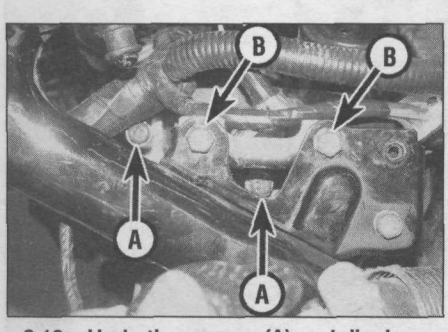
11 To remove the rear cylinder coils, remove the rider's seat (see Chapter 8). Mark the locations of all wires and leads before disconnecting them. When removing the left-



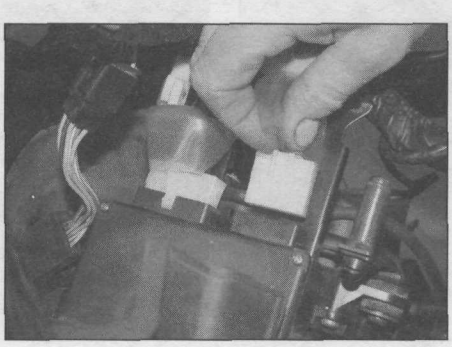
3.10a Free the relay from the bracket



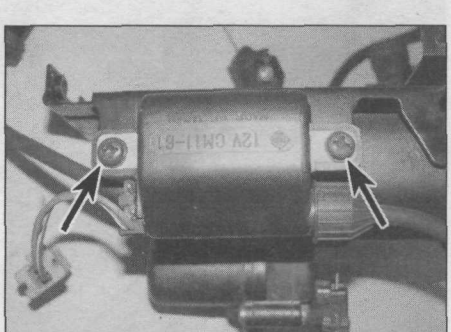
3.10b Disconnect the vacuum hose and wiring connector from the advance unit



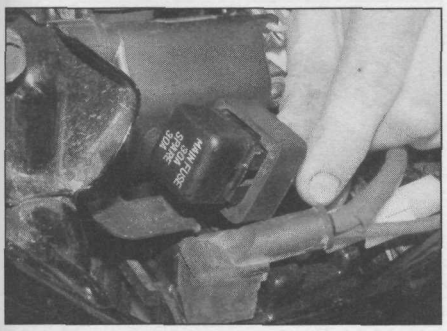
3.10c Undo the screws (A) and displace the V-Boost servo, then unscrew the bracket bolts (B) on each side



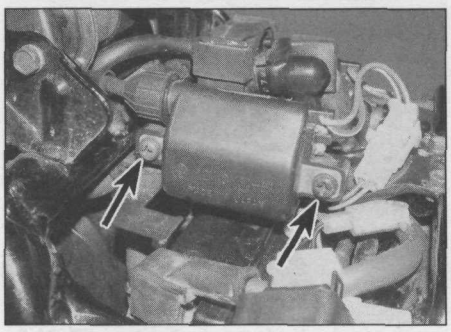
3.10d Disconnect the ICU wiring connectors



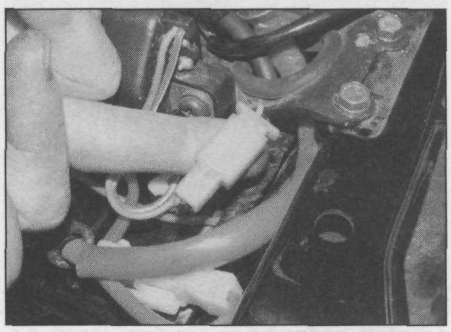
3.10e Coil mounting screws (arrowed)



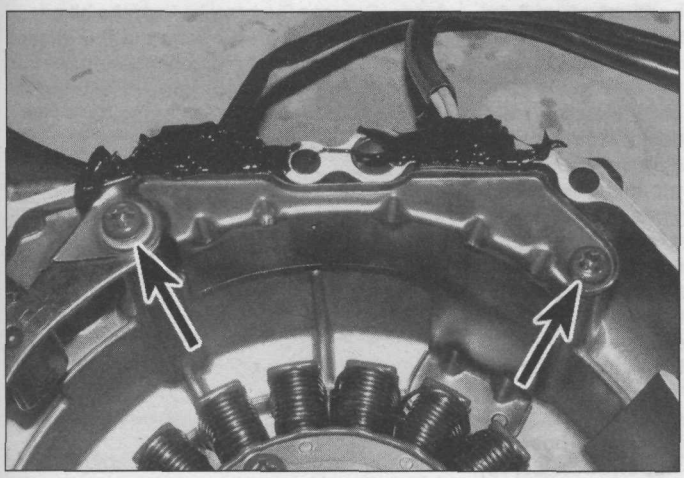
3.11a Displace the main fuseholder to access the left-hand coil screws



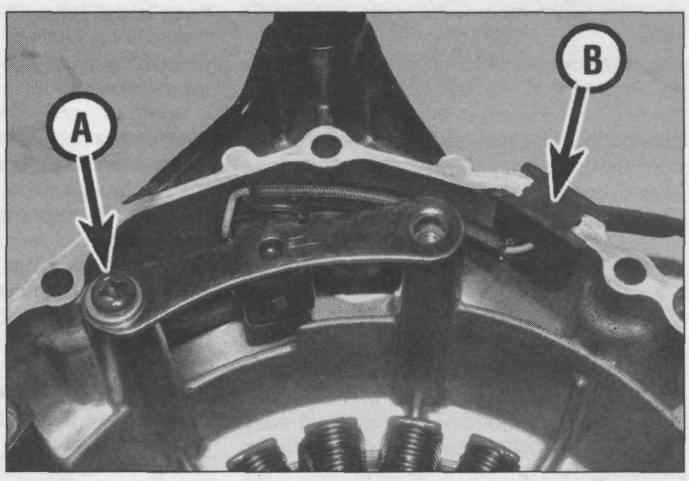
3.11b Coil mounting screws (arrowed)



4.2 Disconnect the pick-up coil wiring connector – single coil type shown



4.8a Undo the screws (arrowed) and remove the guide



4.8b Undo the remaining screw (A), then free the grommet (B) and remove the pick-up coil assembly – single coil type shown

hand coil displace the main fuseholder **(see illustration)**. Disconnect the coil primary circuit wiring connector **(see illustration 3.5c)**, then either unscrew the HT leads from the coils **(see illustration 3.6a)**, or pull the caps off the spark plugs leaving the HT leads attached to the coils – note the routing of the HT leads. Undo the screws securing the coils and remove them **(see illustration)**.

Installation

12 Installation is the reverse of removal. Make sure the wiring connectors and HT leads are securely connected.

4 Pick-up coil(s) – check and renewal

Check

1 Make sure the ignition is switched OFF. Remove the rider's seat (see Chapter 8).

2 Trace the pick-up coil wiring from the alternator cover on the left-hand side of the engine and disconnect it at the connector near the rear cylinder ignition coils **(see illustration)**. Perform the following check(s).

3 On 1985 to 1989 models with twin pick-up coils, using a multimeter set to the ohms x 100 scale, connect the positive (+ve) probe to the orange wire terminal on the pick-up coil side of the connector and the negative (–ve) probe to each of the other terminals in turn, taking four readings, and measure the resistance. If the reading is different to that specified at the beginning of the chapter, first check the connector and the wiring between the connector and the coils themselves (see below to access them). If the wiring is good, replace the coils with new ones – they are not available individually.

4 On 1990 to 2003 models with a single pick-up coil, using a multimeter set to the ohms x 100 scale, connect the positive (+ve) probe to the orange wire terminal on the pick-up coil side of the connector and the negative (–ve) probe to the black wire terminal and measure the resistance. If the reading is different to that specified at the beginning of the chapter, first check the connector and the wiring between the connector and the coil itself (see below to access it). If the wiring is good, replace the coil with a new one.

Renewal

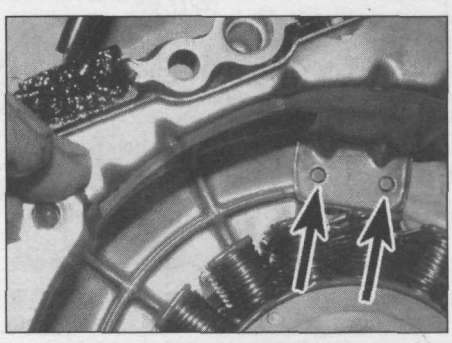
5 Make sure the ignition is switched OFF. Remove the rider's seat (see Chapter 8).

6 Trace the pick-up coil wiring from the alternator cover on the left-hand side of the engine and disconnect it at the connector near the rear cylinder ignition coils **(see illustration 4.2)**. Feed the wiring back to the coil, noting its routing and releasing it from any clips or ties.

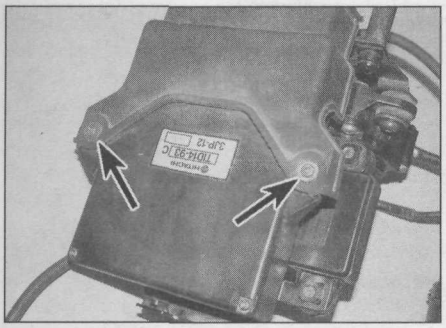
7 Remove the alternator cover (see Chapter 9).

8 Undo the wiring guide screws and remove the guide, noting how it locates **(see illustration)**. Undo the pick-up coil screws and remove the coil(s), freeing the wiring grommet from the crankcase as you do **(see illustration)**.

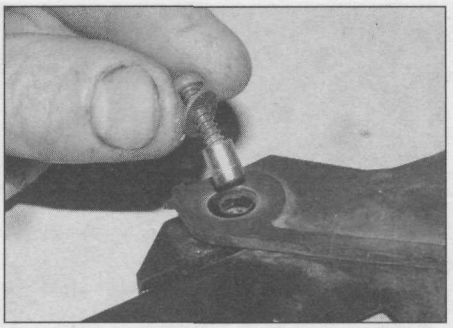
9 Fit the pick-up coil assembly and wiring guide, locating the holes in the guide over the pegs in the cover, and secure them with their screws **(see illustration)**. Smear some sealant



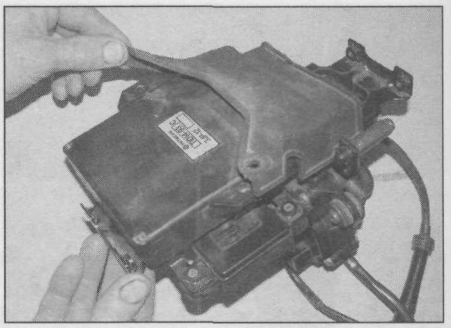
4.9 Make sure the holes locate over the pegs (arrowed)



5.6a Undo the screws (arrowed) . . .



5.6b . . . noting the collars . . .



5.6c . . . then remove the sleeve and the ICU

onto the wiring grommet and press it into its cut-out.

10 Install the alternator cover (see Chapter 9).

11 Route the wiring back up to the connector, securing it with any clips or ties previously released and making sure it is correctly routed, and reconnect it **(see illustration 4.2)**. Install the rider's seat (see Chapter 8).

5 Ignition control unit – check, removal and installation

Check

1 If the tests shown in the preceding or following Sections have failed to isolate the cause of an ignition fault, it is possible that the ignition control unit itself is faulty. No test details are available with which the unit can be tested.

Removal

2 Remove the rider's seat (see Chapter 7). Disconnect the battery negative (–ve) lead.

3 Remove the air filter housing, and for best access the carburettors (see Chapter 4). Undo the screws securing the electrical component board on the left-hand side of the steering head and displace it **(see illustration 3.4a)**. There is no need to disconnect any wiring connectors or detach any of the components from the board.

4 Remove the cover from the radiator filler neck on the right-hand side of the frame **(see illustration 3.4b)**. Undo the screws securing the radiator filler neck mounting board and displace it – there is no need to drain the cooling system or detach any hoses, but watch the wiring and disconnect the connectors if necessary **(see illustration 3.4c)**. Mark the locations of all wires and leads before disconnecting them.

5 Free the relay from its mount on the left-hand side of the ignition control unit mounting bracket **(see illustration 3.10a)**. Disconnect the ignition advance unit vacuum hose and wiring connector **(see illustration 3.10b)**. Undo the two screws securing the V-Boost servo motor and displace it (full power models) **(see illustration 3.10c)**. Unscrew the four bolts securing the bracket and manoeuvre it out, and disconnect the ignition control unit wiring connectors **(see illustration 3.10d)**, the coil primary circuit wiring connectors **(see illustrations 3.5a and b)**, then either unscrew the HT lead retainers and detach the leads from the coils or pull the caps off the spark plugs, leaving the HT leads attached to the coils – note the routing of the leads. Remove the bracket from the bike.

6 Remove the screws securing the ignition control unit, noting the collars, then remove the rubber sleeve and remove the unit **(see illustrations)**.

Installation

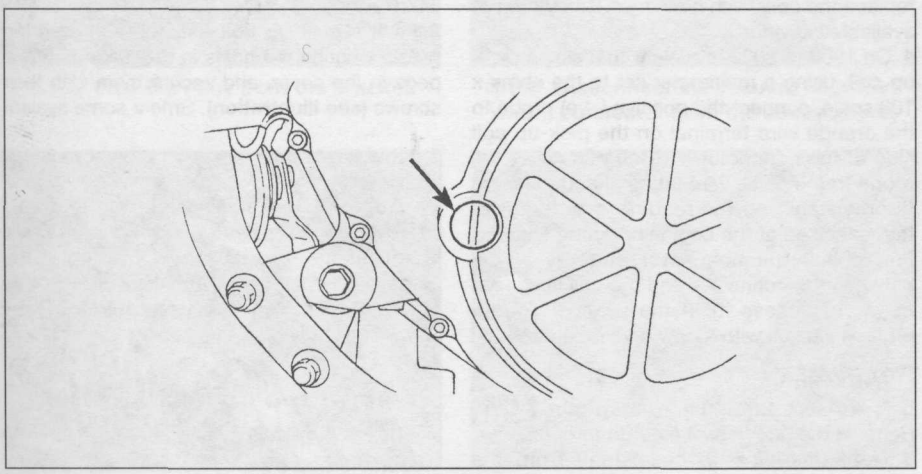
7 Installation is the reverse of removal. Make sure the wiring connectors are correctly and securely connected.

6 Ignition timing – general information and check

General information

1 Since no provision exists for adjusting the ignition timing and since no component is subject to mechanical wear, there is no need for regular checks; only if investigating a fault such as a loss of power or a misfire, should the ignition timing be checked.

2 The ignition timing is checked dynamically (engine running) using a stroboscopic lamp. The inexpensive neon lamps should be adequate in theory, but in practice may produce a pulse of such low intensity that the timing mark remains indistinct. If possible, one of the more precise xenon tube lamps should be used, powered by an external source of the appropriate voltage. **Note:** *Do not use the machine's own battery as an incorrect reading may result from stray impulses within the machine's electrical system.*



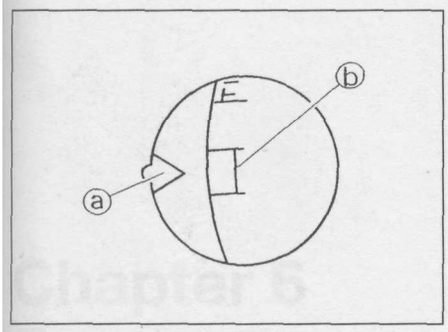
6.4 Timing mark inspection plug

Check

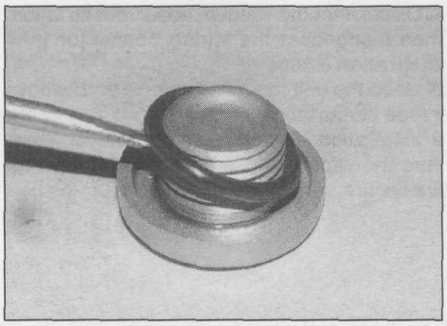
3 Warm the engine up to normal operating temperature then stop it.

4 Unscrew the timing mark inspection plug from the alternator cover on the left-hand side of the engine **(see illustration)**. Discard the O-ring as a new one must be used.

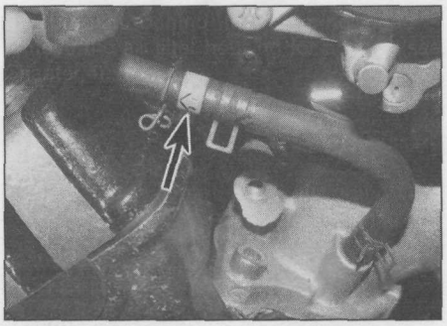
5 The dynamic timing mark on the rim of the alternator rotor which indicates the firing point range at idle speed for the No. 1 cylinder is the 'H' mark next to the line that is next to the T1 mark **(see illustration)**. The static timing mark with which this should align is the notch in the inspection plug rim. Note that the timing marks are difficult to see – you have to look in



6.5 Notch in inspection plug rim (a) and timing mark on alternator rim (b)



6.10 Fit a new O-ring onto the inspection plug and smear it with grease



7.2 Check the hose as described. Note the nozzle (arrowed) with the directional arrow

at an angle from the front as the marks are not directly visible from the side.

> **HAYNES HiNT** ***The timing marks can be highlighted with white paint to make them more visible under the stroboscope light.***

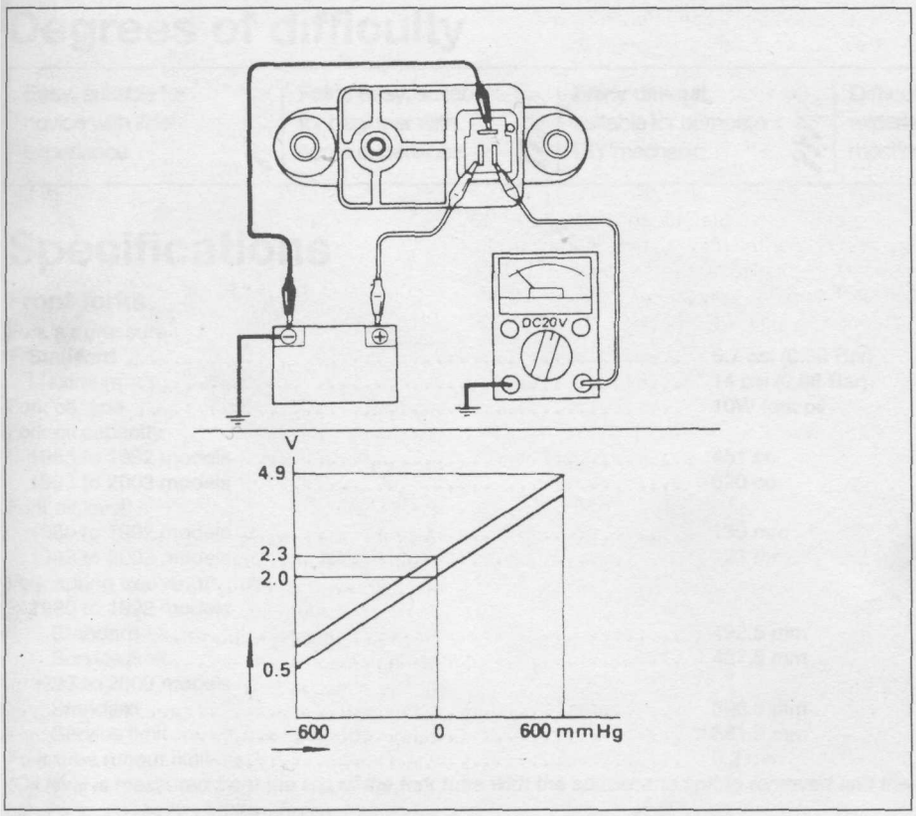
6 Connect the timing light to the No. 1 cylinder HT lead.

7 Start the engine and aim the light at the static timing mark.

8 With the machine idling, the 'H' mark should align with the static timing mark (see Step 5). Now increase engine speed – using the idle speed adjuster will be more accurate than opening the throttle. At this point the 'H' mark should move clockwise in relation to the static mark. This confirms the ignition is advancing. There is no full advance mark on the rotor.

9 As already stated, there is no means of adjustment of the ignition timing on these machines. If the ignition timing is incorrect, or suspected of being incorrect, one of the ignition system components is at fault, and the system must be tested as described in the other Sections of this Chapter – start with the ignition advance unit vacuum hose, then the unit itself (see Section 7).

10 When the check is complete, install the timing inspection plug using a new O-ring, and smear it and the threads with grease **(see illustration)**.



7.4 Ignition advance unit test set-up and vacuum/output graph

7 Ignition advance unit – check, removal and installation

1 The ignition advance unit is mounted on the bracket behind the steering head – remove the air filter housing for access (see Chapter 4).

Check

2 First check that the vacuum hose from the No. 2 cylinder intake duct is securely connected at each end and is in good condition – any cracks will affect vacuum in the hose and therefore the timing advance **(see illustration)**. Replace the hose with a new one if in doubt as to its condition. If you fit a new one, note that it comes in two separate sections with a one-way nozzle between them – the nozzle has a directional arrow which must point to the ignition advance unit.

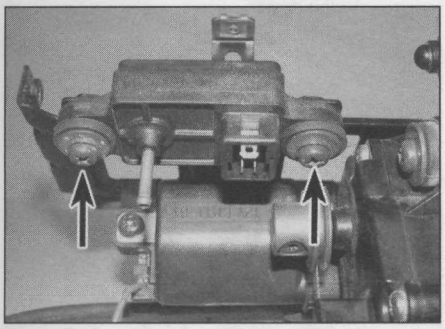
3 Remove the unit (see below).

4 Set up a voltmeter or multimeter set to the 0-20 volt dc range and a fully charged 12 volt battery, connected as shown, and measure the output voltage of the advance unit **(see illustration)**. It should be 2 volts. If not, replace the unit with a new one. Note that if you have a calibrated vacuum gauge you can apply a vacuum within the range shown to the hose union and check that the voltage output varies with the vacuum according to the graph shown. If it doesn't behave according to the graph, replace it with a new one.

5 If the reading is good, check for continuity in the black/red and black/yellow wires between the advance unit and the ignition control unit, referring to the *Wiring Diagrams* at the end of Chapter 9, and check the terminals in the connectors. Also check for battery voltage at the red/white or red/black wire terminal (according to model) on the loom side of the connector with the ignition ON.

Removal and installation

6 The ignition advance unit is mounted on the bracket behind the steering head – remove the air filter housing for access (see Chapter 4).



7.8 Ignition advance unit mounting screws (arrowed) – unit removed for clarity

7 Disconnect the vacuum hose from its union, then disconnect the wiring connector **(see illustration 3.10b)**.
8 Undo the unit mounting screws and remove it **(see illustration)**.
9 Installation is the reverse of removal. Make sure the vacuum hose and wiring connector are secure.